Complete Summary

GUIDELINE TITLE

Guidelines and recommendations for perfusion imaging in cerebral ischemia.

BIBLIOGRAPHIC SOURCE(S)

Latchaw RE, Yonas H, Hunter GJ, Yuh WT, Ueda T, Sorensen AG, Sunshine JL, Biller J, Wechsler L, Higashida R, Hademenos G. Guidelines and recommendations for perfusion imaging in cerebral ischemia: A scientific statement for healthcare professionals by the writing group on perfusion imaging, from the Council on Cardiovascular Radiology of the American Heart Association. Stroke 2003 Apr;34(4):1084-104. [220 references] PubMed

GUIDELINE STATUS

This is the current release of the guideline.

COMPLETE SUMMARY CONTENT

SCOPE

DISEASE/CONDITION(S)

Acute and chronic cerebral ischemia caused by acute stroke, chronic vascular occlusive disease, vasospasm (secondary to subarachnoid hemorrhage), and head injury

GUIDELINE CATEGORY

Diagnosis
Evaluation
Management
Risk Assessment
Technology Assessment

CLINICAL SPECIALTY

Cardiology
Neurology
Radiology

INTENDED USERS

Health Care Providers
Physicians

GUIDELINE OBJECTIVE(S)

- To summarize what is known about the clinically available perfusion technologies, specifically xenon-enhanced computed tomography (XeCT), computed tomography perfusion imaging (CTP), single photon emission computed tomography (SPECT), and perfusion-weighted magnetic resonance imaging (PWI) (and the associated diffusion-weighted magnetic resonance imaging (DWI)), in their role of evaluating acute and chronic cerebral ischemic conditions
- To indicate the strengths and weaknesses of each technique
- To make recommendations as to the use of each technique
- To indicate the need for future research
- To give impetus to the improvement and perfection of these techniques, the direct comparison of their ability to provide significant information, and the formation of studies to prove that perfusion imaging has a role in improving patient outcomes

TARGET POPULATION

Patients with acute and chronic cerebral ischemia caused by acute stroke, chronic vascular occlusive disease, vasospasm (secondary to subarachnoid hemorrhage), and head injury

Note: Traumatic head injury is included because of its close relationship to ischemic injury, but the use of perfusion imaging in other diseases, such as neoplasms and inflammatory conditions, has not been evaluated.

INTERVENTIONS AND PRACTICES CONSIDERED

Diagnostic Evaluation

Perfusion Imaging

Diffusible Tracer Techniques

1. Xenon-enhanced computed tomography (CT) (XeCT)
2. Single photon emission CT (SPECT)

Nondiffusible Tracer Techniques

1. CT perfusion (slow-infusion/whole-brain technique and first-pass bolus-tracking methodology)
2. Perfusion-weighted magnetic resonance (MR) imaging (PWI)
3. Diffusion-weighted MR imaging (DWI)

Other

1. Perfusion imaging with a challenge test (e.g., Intravenous injection of 1 g of the vasodilating agent acetazolamide [diamox])
2. CT angiography (CTA)
3. Balloon occlusion test (BOT)

Note: Positron emission tomography (PET) scanning is excluded because it is primarily a research tool in academic institutions.

MAJOR OUTCOMES CONSIDERED

- Morbidity and mortality
- Cerebral blood flow
- Neurological symptoms
- Accuracy, reproducibility, and reliability of data
- Availability, costs, and reimbursement

METHODOLOGY

METHODS USED TO COLLECT/SELECT EVIDENCE

Searches of Electronic Databases

DESCRIPTION OF METHODS USED TO COLLECT/SELECT THE EVIDENCE

Not stated

NUMBER OF SOURCE DOCUMENTS

Not stated

METHODS USED TO ASSESS THE QUALITY AND STRENGTH OF THE EVIDENCE

Weighting According to a Rating Scheme (Scheme Given)

RATING SCHEME FOR THE STRENGTH OF THE EVIDENCE

Level of Evidence

Class I: Evidence provided by a prospective study in a broad spectrum of subjects with the suspected condition, using a "gold standard" for case definition. The interpreters of the test and those providing treatment decisions and assessing

outcome are each blinded to any data from the other, enabling assessment of the diagnostic accuracy of the test.

Class II: Evidence provided by a prospective study in a narrow spectrum of subjects with the suspected condition, or a well-designed retrospective study of a broad spectrum of subjects with an established condition (using a "gold standard") compared with a broad spectrum of control subjects. The interpreters of the test and those providing treatment decisions and assessing outcome are each blinded to any data from the other, enabling assessment of the diagnostic accuracy of the test.

Class III: Evidence supplied by a retrospective study in which either the subjects with an established condition or the controls are of a narrow spectrum. The interpreters of the test and those providing treatment decisions and assessing outcome are each blinded to any data from the other, enabling assessment of the diagnostic accuracy of the test.

Class IV: Any study design in which the interpretation of the test is not blinded relative to any treatment decision or outcome assessment, the treatment decision or outcome assessment is not blinded to the test interpretation, the evidence is provided by "expert opinion" alone, or there is only a descriptive series without controls.

METHODS USED TO ANALYZE THE EVIDENCE

Review

DESCRIPTION OF THE METHODS USED TO ANALYZE THE EVIDENCE

One of the purposes of this guideline is to assess the quality of studies of imaging techniques to determine the grade of recommendation that can be made for their use today and to guide the direction of future research. The rules of evidence for evaluating the quality and reliability of diagnostic tests such as perfusion imaging must obviously differ from those used to evaluate clinical studies. A committee of the American Academy of Neurology developed a scheme of evidence classification for diagnostic testing to evaluate reports of techniques that test the vestibular system. However, imaging studies differ from other types of diagnostic tests in important ways, because the data must often be interpreted by subjective rather than purely objective criteria. In addition, adequate clinical history is often necessary for an appropriate interpretation to be made. One way to assess the accuracy of an imaging study such as perfusion imaging is to gauge its ability to predict outcome, with or without subsequent treatment. This outcome may not be actual patient outcome but may be an outcome related to the tissue in question, such as the development of infarction. Another method of evaluation, possibly of even more importance, is an assessment of the ability of the information derived from the imaging test to influence the selection of subsequent medical management. For perfusion imaging, the ideal impartial assessment of the accuracy and influence of a given technique would require that the interpreters of the test be blinded, prospectively or retrospectively, to both the subsequent subject management and outcome and that the individuals making treatment decisions and outcome assessments be blinded to the results of the imaging study. A scheme to evaluate the perfusion literature has been developed with

these considerations in mind, representing a modification of that found in the report by Fife et al. The schemes are presented in this summary under "Rating Scheme for the Strength of the Evidence" and "Rating Scheme for the Strength of the Recommendations."

METHODS USED TO FORMULATE THE RECOMMENDATIONS

Expert Consensus

DESCRIPTION OF METHODS USED TO FORMULATE THE RECOMMENDATIONS

Not stated

RATING SCHEME FOR THE STRENGTH OF THE RECOMMENDATIONS

Strength of Recommendation

Grade A: Established as a useful/predictive or not useful/predictive test for the given condition in the specified population. Requires at least one class I study or two class II studies.

Grade B: Probably useful/predictive or not useful/predictive test for the given condition in the specified population. Requires at least one class II study or three class III studies.

Grade C: Possibly useful/predictive or not useful/predictive test for the given condition in the specified population. Requires at least two class III studies.

Grade D: Data are inadequate or conflicting. Given current knowledge, the test is unproven.

COST ANALYSIS

A formal cost analysis was not performed and published cost analyses were not reviewed.

METHOD OF GUIDELINE VALIDATION

Peer Review

DESCRIPTION OF METHOD OF GUIDELINE VALIDATION

This statement was approved by the American Heart Association Science Advisory and Coordinating Committee in December 2002. It was published in Stroke 2003;34:1084-1104.

RECOMMENDATIONS

MAJOR RECOMMENDATIONS

Definitions of the levels of evidence (Classes I-IV) and strength of the recommendations (Grades A-D) are provided at the end of the "Major Recommendations" field.

Xenon-enhanced Computed Tomography (XeCT)

1. With increased availability of stable xenon gas, it is imperative that more centers evaluate the utility of this technology in numerous clinical conditions.
2. Quantitative data, especially absolute values of perfusion, may be helpful as an aid in determining the risks and benefits of revascularization of the acute stroke patient, including post-thrombolysis hemorrhage, and XeCT can be used to acquire such information (grade A).
3. Prospective controlled outcome studies of acute stroke patients treated with revascularization after XeCT studies, with blinding of their cerebral blood flow (CBF) values, must be undertaken in order to prove the predictability of the quantitative data.
4. Prospective outcome studies following the recanalization of acute stroke patients, with and without XeCT perfusion imaging and blinded to specific CBF levels if acquired, must be undertaken to evaluate the relative benefits of earlier treatment versus the time-consuming acquisition of physiological data that may predict outcome and risk.
5. XeCT perfusion imaging with an acetazolamide challenge test can be used to define a group of patients with chronic ischemia who are at significant risk for infarction (grade A). Larger prospective studies are necessary, along with prospective comparative studies, to determine whether a flow augmentation bypass can reduce the risk predicted by XeCT.
6. CBF levels obtained with XeCT, combined with studies of autoregulation and the responses to physiological challenges, can probably be used to accurately predict outcome following head trauma (grade B). Larger prospective and comparative studies should be undertaken to prove the validity of this utilization.

Single Photon Emission Computed Tomography (SPECT)

1. SPECT CBF studies can be used to determine the relative risks of hemorrhage following thrombolysis of acute stroke patients, whatever the time after onset of symptoms (grade A).
2. Because both the quantitative (XeCT) and semi-quantitative (SPECT) methods provide class I data regarding the risks of hemorrhage following thrombolysis, and both may be helpful in identifying patients at greater risk of hemorrhage after thrombolysis, comparative studies must be undertaken to determine the relative merits of the 2 methodologies. Studies should also be performed to determine the value of the time expenditure in obtaining such data.
3. Because the SPECT data obtained with challenge tests cannot be controlled, the reliability of this technique to evaluate patients with chronic ischemia is unproven (grade D). These techniques should be compared with more stable, quantitative methodologies to determine their role in such assessment.
4. The SPECT CBF technique is unproven (class IV data) in determining the presence of clinically significant vasospasm and for predicting infarction following carotid artery sacrifice (grade D). These techniques should be compared with more rigorous, quantitative methodologies.

5. The value of SPECT CBF in head-injured patients is unproven (grade D).

CT Perfusion (CTP)

Slow-infusion/Whole-brain Technique and First-pass Bolus-tracking Methodology

1. Quantitative CTP may possibly be useful to differentiate between reversibly and irreversibly ischemic tissues in the acute stroke patient (grade C). Large prospective and appropriately blinded studies will be necessary to determine the value of this technique. There are no data regarding the ability of this technique to predict the potential for hemorrhage following thrombolysis, as there is for the diffusible tracer techniques.
2. Qualitative mapping of cerebral blood volume (CBV) with the slow-infusion method, in combination with the acquisition of CT angiography (CTA), may possibly be of value to determine emergent forms of therapy for the acute stroke patient (grade C). Again, larger prospective studies are needed.
3. No recommendation can be made for the use of this technique in patients with chronic ischemia, vasospasm, head trauma, or as part of the balloon occlusion test (BOT) (grade D).

Perfusion-weighted (PWI) and Diffusion-weighted (DWI) Magnetic Resonance (MR) Imaging

1. Perfusion and diffusion MR can be recommended as techniques that have been proven capable of demonstrating severely ischemic tissue in the acute stroke patient. These techniques are probably useful at differentiating between reversibly and irreversibly ischemic tissues (grade B), although the issue of reversibility of a diffusion abnormality, especially in the early stages of ischemia, requires more study.
2. No recommendation can be given for the ability of these techniques to guide the use of treatment modalities such as thrombolysis in the acute stroke patient, nor in their use to predict complications from that treatment, such as postthrombolytic hemorrhage (grade D).
3. No recommendation can be made regarding the ability of these techniques to provide accurate information on the status of vascular reserves in patients with chronic ischemia or in patients with vasospasm or head trauma. No information is available regarding their use as part of the BOT (grade D).

Definitions

Strength of Recommendation

Grade A: Established as a useful/predictive or not useful/predictive test for the given condition in the specified population. Requires at least one class I study or two class II studies.

Grade B: Probably useful/predictive or not useful/predictive test for the given condition in the specified population. Requires at least one class II study or three class III studies.

Grade C: Possibly useful/predictive or not useful/predictive test for the given condition in the specified population. Requires at least two class III studies.

Grade D: Data are inadequate or conflicting. Given current knowledge, the test is unproven.

Level of Evidence

Class I: Evidence provided by a prospective study in a broad spectrum of subjects with the suspected condition, using a "gold standard" for case definition. The interpreters of the test and those providing treatment decisions and assessing outcome are each blinded to any data from the other, enabling assessment of the diagnostic accuracy of the test.

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CLINICAL ALGORITHM(S)

None provided

EVIDENCE SUPPORTING THE RECOMMENDATIONS

TYPE OF EVIDENCE SUPPORTING THE RECOMMENDATIONS

The type of supporting evidence is identified and graded for some of the recommendations (see "Major Recommendations").

BENEFITS/HARMS OF IMPLEMENTING THE GUIDELINE RECOMMENDATIONS

POTENTIAL BENEFITS

Improved familiarity and understanding of clinically available perfusion technologies, and their role of evaluating acute and chronic cerebral ischemic conditions

POTENTIAL HARMS

Not stated

IMPLEMENTATION OF THE GUIDELINE

DESCRIPTION OF IMPLEMENTATION STRATEGY

An implementation strategy was not provided.

INSTITUTE OF MEDICINE (IOM) NATIONAL HEALTHCARE QUALITY REPORT CATEGORIES

IOM CARE NEED

Getting Better
Living with Illness

IOM DOMAIN

Effectiveness

IDENTIFYING INFORMATION AND AVAILABILITY

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ADAPTATION

Not applicable: The guideline was not adapted from another source.

DATE RELEASED

2003 Apr

GUIDELINE DEVELOPER(S)

American Heart Association - Professional Association
American Stroke Association - Disease Specific Society

SOURCE(S) OF FUNDING

American Heart Association

GUIDELINE COMMITTEE

Writing Group on Perfusion Imaging, From the Council on Cardiovascular Radiology

COMPOSITION OF GROUP THAT AUTHORED THE GUIDELINE

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FINANCIAL DISCLOSURES/CONFLICTS OF INTEREST

The American Heart Association makes every effort to avoid any actual or potential conflicts of interest that may arise as a result of an outside relationship or a personal, professional, or business interest of a member of the writing panel. Specifically, all members of the writing group are required to complete and submit a Disclosure Questionnaire showing all such relationships that might be perceived as real or potential conflicts of interest.

GUIDELINE STATUS

This is the current release of the guideline.

GUIDELINE AVAILABILITY

Electronic copies: Available from the American Heart Association Web site:

- HTML Format
- Portable Document Format (PDF)

Print copies: Available from the American Heart Association, Public Information, 7272 Greenville Ave, Dallas, TX 75231-4596; Phone: 800-242-8721

AVAILABILITY OF COMPANION DOCUMENTS

None available

PATIENT RESOURCES

None available

NGC STATUS

This NGC summary was completed by ECRI on October 15, 2004. The information was verified by the guideline developer on December 14, 2004.

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